Practitioner's Docket No. AP8985 **PATENT**

TRANSMITTAL LETTER TO THE U.S. DESIGNATED OFFICE (DO/US)— ENTRY INTO THE U.S. NATIONAL STAGE UNDER CHAPTER I

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP98/01798	26 March 1998	5 April 1997

TITLE OF INVENTION
Electromechanically Actuated Parking Brake for Motor Vehicles

APPLICANT(S)
Rolf Weiler; Jurgen Balz; Werner Denhard

Box PCT
Assistant Commissioner for Patents
Washington D.C. 20231

ATTENTION: DO/US

NOTE: The completion of those filing requirements that can be made at a time later than 20 months from the priority date results from the Commissioner exercising his judgment under the authority granted under 35 U.S.C. § 371(d). The filing receipt will show the actual date of receipt of the last item completing the entry into the national phase. See 37 C.F.R. § 1.491, which states: "An international application enters the national stage when the applicant has filed the documents and fees required by 35 USC 371(c) within the periods set forth in § 1.494 and § 1.495."

***WARNING:** Where the items are those that can be submitted to complete the entry of the international application into the national phase subsequent to 20 months from the priority date, the application is still considered to be in the international stage. And if mailing procedures are utilized to obtain a date the express mail procedure of 37 C.F.R. § 1.10 must be used (because international application papers are not covered by an ordinary certificate of mailing. 37 C.F.R. § 1.8(2)(xi)).*

NOTE: Documents and fees must be clearly identified as a submission to enter the national stage under 35 U.S.C. § 371, otherwise the submission will be considered as being made under 35 U.S.C. § 111. 37 C.F.R. § 1.494(f).

CERTIFICATION UNDER 37 C.F.R. § 1.10*
(Express Mail label number is mandatory.)
(Express Mail certification is optional.)

I hereby certify that this Transmittal Letter and the papers indicated as being transmitted therewith is being deposited with the United States Postal Service on this date 12/7/98, in an envelope as "Express Mail Post Office to Addressee," mailing Label Number EL134825407US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Joyce Krumpe
(type or print name of person mailing paper)

Joyce Krumpe
Signature of person mailing paper

***WARNING:** Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. § 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.*

***WARNING:** Each paper or fee filed by "Express Mail" **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. § 1.10(b).*
*"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.*

1. Applicant herewith submits to the United States Designated Office (DO/US) the following items under 35 U.S.C. § 371:

a. ☑ This express request to immediately begin national examination procedures (35 U.S.C. § 371(f)).

b. ☒ The U.S. National Fee (35 U.S.C. § 371(c)(1)) and other fees (37 C.F.R. § 1.492), as indicated below:

2. Fees

CLAIMS FEE	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
☐*	TOTAL CLAIMS	37 —20=	17	×$ 22.00= 18	$ 306.00
	INDEPENDENT CLAIMS	1 —3=		×$ 82.00=	
	MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $270.00	
BASIC FEE**	The international search fee, as set forth in § 1.445(a)(2) to be paid to the US PTO acting as an international Searching Authority: ☐ has not been paid (37 CFR 1.492(a)(2)) ..... $790.00 ☐ has not been paid (37 CFR 1.492(a)(3)) ..... $1,070.00 ☒ where a search report on the international application has been prepared by the European Patent Office or the Japanese Patent Office (37 CFR 1.492(a)(5)) $930.00				840.00
	Total of above Calculations				=
SMALL ENTITY	Reduction by for filing by small entity, if applicable. Affidavit must be filed also. (note 37 CFR 1.9, 1.27, 1.28)				–
	Subtotal				
	Total National Fee				$
	Fee for recording the enclosed assignment document $40.00 (37 CFR 1.21(h)). (See Item 10 below). See attached "ASSIGNMENT COVER SHEET (37 CFR 3.34)".				
TOTAL	Total Fees enclosed				$ 1146.00

* See attached Preliminary Amendment Reducing the Number of Claims.

***WARNING:** *"To avoid abandonment of the application, the applicant shall furnish to the United States Patent and Trademark Office not later than the expiration of 20 months from the priority date: * * * (2) the basic national fee (see § 1.492(a)). The 20-month time limit may not be extended." 37 C.F.R. § 1.494(b).*

i. ☐ A check in the amount of $ _____ to cover the above fees is enclosed.

ii. ☒ Please charge Account No. 18-0013 in the amount of $ 1146.00.

A duplicate copy of this sheet is enclosed.

***WARNING:** *If the translations of the international application, oath or declaration and national fee have not been submitted by the applicant within twenty (20) months from the priority date, the applicant will be so notified and given a period of time within which to file the translation and/or oath or declaration in order to prevent abandonment. The payment of the surcharge set forth in § 1.492(e) is required as a condition for accepting the oath or declaration later than twenty (20) months after the priority date. The payment of the processing fee set forth in § 1.492(f) is required for acceptance of an English translation later than twenty (20) months after the priority date. Failure to comply with these requirements will result in abandonment of the application. The provisions of § 1.136 will apply. 37 C.F.R. § 1.494(c); Notice of Jan. 7, 1993, 1147 O.G. 29 to 40, at 35.*

3. A copy of the International application as filed (35 U.S.C. § 371(c)(2)):

a. ☒ is transmitted herewith.

b. ☐ is not required, as the application was filed with the United States Receiving Office.

c. ☐ has been transmitted

i. ☐ by the International Bureau. Date of mailing of the application (from form PCT/IB/308): _____.

ii. ☐ by applicant on _____ (Date).

NOTE: Section 1.494(b) was amended to require that the basic national fee and a copy of the international application must be filed with the Office by 20 months from the priority date to avoid abandonment. "The International Bureau normally provides the copy of the international application to the Office in accordance with PCT Article 20. At the same time, the International Bureau notifies the applicant of the communication to the Office. In accordance with PCT Rule 47.1, that notice shall be accepted by all designated offices as conclusive evidence that the communication has duly taken place. Thus, if the applicant desires to enter the national stage and applicant has received notice from the International Bureau, applicant need only pay the basic national fee by 20 months from the priority date." [This can now be paid subsequently with a surcharge.] Notice of Jan. 7, 1993, 1147 O.G. 29 to 40, at 35.

4. ☒ A translation of the International application into the English language (35 U.S.C. § 371(c)(2)):

a. ☒ is transmitted herewith.

b. ☐ is not required as the application was filed in English.

c. ☐ was previously transmitted by applicant on _____ (Date).

5. ☐ Amendments to the claims of the International application under PCT Article 19 (35 U.S.C. § 371(c)(3)):

NOTE: *The Notice of January 7, 1993 indicates that 37 C.F.R. § 1.494(d) was "amended to clarify the existing practice that PCT Article 19 Amendments must be submitted by 20 months from the priority date, which time may not be extended." This Notice further advises: "Of course, the failure to do so does not result in loss of the subject matter of PCT Article 19 amendments. The applicant may submit that subject matter in a preliminary amendment filed under Section 1.121. In many cases, filing an amendment under Section 1.121 is preferable since grammatical or idiomatic errors may be corrected." 1147 O.G. 29-40, at 35. See item 11(c) below.*

a. ☐ are transmitted herewith.

b. ☐ have been transmitted

i. ☐ by the International Bureau. Date of mailing of the amendment (from form PCT/IB/308): _____.

ii. ☐ by applicant on _____. Date

c. ☐ have not been transmitted, as

i. ☐ no notification has been received that the International Search Authority has received the Search Copy.

ii. ☐ the Search Copy was received by the International Searching Authority, but the Search Report has not yet been issued. Date of receipt of Search Copy (from form PCT/ISA/202): _____.

iii. ☐ applicant chose not to make amendments under PCT Article 19. Date of mailing of Search Report (from form PCT/ISA/210): _____.

iv. ☐ the time limit for the submission of amendments has not yet expired. The amendments, or a statement that amendments have not been made, will be transmitted before the expiration of the time limit under PCT Rule 46.1.

6. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. § 371(c)(3)):

a. ☐ is transmitted herewith.

b. ☐ is not required as the amendments were made in the English language.

c. ☐ has not been transmitted for reasons indicated at point 5(c) above.

7. ☒ An oath or declaration of the inventor (35 U.S.C. § 371(c)(4)) complying with 35 U.S.C. § 115

a. ☐ was previously submitted by applicant on _____. Date

b. ☐ is submitted herewith, and such oath or declaration

i. ☐ is attached to the application.

ii. ☐ identifies the application and any amendments under PCT Article 19 that were transmitted as stated in points 3(b) or (c) and 5(b); and states that they were reviewed by the inventor, as required by 37 C.F.R. § 1.70.

iii. ☒ will follow.

II. Other document(s) or information included:

8. ☒ An international Search Report or Declaration under PCT Article 17(2)(a):
   a. ☒ is transmitted herewith.
   b. ☐ has been transmitted by the International Bureau. Date of mailing (from form PCT/IB/308): _____.
   c. ☐ is not required, as the application was searched by the United States International Searching Authority.
   d. ☐ will be transmitted promptly upon request.
   e. ☐ has been submitted by applicant on _____ Date
   f. ☐ is not transmitted, as the international search has not yet issued.
9. ☒ An Information Disclosure Statement under 37 C.F.R. §§ 1.97 and 1.98:
   a. ☒ is transmitted herewith.
      Also transmitted herewith is (are)
      ☒ Form PTO—1449 (PTO/SB/08A and 08B)
      ☒ Copies of citations listed
   b. ☐ will be transmitted within THREE MONTHS of the date of submission of requirements under 35 U.S.C. § 371(c).
   c. ☐ was previously submitted by applicant on _____ Date
10. ☐ An assignment document is transmitted herewith for recording. A separate
   ☐ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or
   ☐ FORM PTO—1595
   is also attached.
      ☐ Please mail the recorded assignment document to:
      i. ☐ the person whose signature and address appears below.
      ii. ☐ the following:

11. ☒ Additional documents
    a. ☐ Copy of request (PCT/RO/101)
    b. ☒ International Publication No. WO/98/45152
        i. ☐ Specification, claims and drawing
        ii. ☒ Front page only
    c. ☒ Preliminary amendment (37 C.F.R. § 1.121)
    d. ☐ Other

12. ☒ The above checked items are being transmitted
    a. ☐ before the 18th month publication.
    b. ☒ after publication and the article 20 communication, but before 20 months from the priority date.
    c. ☐ after 20 months (revival).

NOTE: Petition to revive (37 C.F.R. § 1.137(a) or (b)) is necessary if 35 U.S.C. § 371 requirements are submitted after 20 months.

13. ☐ Certain requirements under 35 U.S.C. § 371 were previously submitted by the applicant on _____ (Date) namely:

AUTHORIZATION TO CHARGE ADDITIONAL FEES

WARNING: *Accurately count claims, especially multiple dependant claims, to avoid unexpected high charges if extra claims are authorized.*

NOTE: "A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).

NOTE: "Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).

☒ The Commissioner is hereby authorized to charge the following additional fees that may be required by this paper and during the entire pendency of this application to Account No. 18-0013.

☒ 37 C.F.R. § 1.492(a)(1), (2), (3), and (4) (filing fees)

WARNING: *Because failure to pay the national fee within 20 months without extension (37 CFR § 1.494(b)(2)), results in abandonment of the application, it would be best to always check the above box.*

☒ 37 C.F.R. § 1.492(b), (c), and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment, prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

☒ 37 C.F.R. § 1.17 (application processing fees)

☒ 37 C.F.R. § 1.17(a)(1)–(5) (extension fees pursuant to § 1.136(a)).

☐ 37 C.F.R. § 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. § 1.311(b)).

NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. § 1.311(b).

NOTE: 37 C.F.R. § 1.28(b) requires "Notification of any change in status resulting in loss of entitlement to small entity status must be filed in the application . . . prior to paying or at the time of paying . . . issue fee. . .." From the wording of 37 C.F.R. § 1.28(b): (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

☒ 37 C.F.R. § 1.492(e) and (f) (surcharge fees for filing the declaration and/or filing an English translation of an International Application later than 20 months after the priority date.

Signature of practitioner

Reg. No. 33373

Joseph V. Coppola, Sr.

(type or print name of practitioner)

Tel. No.: (248) 594-0650

1533 N. Woodward Ave., Suite 140

P.O. Address

Customer No.:

Bloomfield Hills MI 48304

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Weiler et al.

Serial No.: To be assigned Group Art Unit:

Filed: Herewith Examiner:

For: Electromagnetically Actuated Parking Brake for Motor Vehicles

Attorney Docket No.: AP 8985

Assistant Commissioner of Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Dear Sir:

Please amend the application as follows prior to examination on the merits:

IN THE CLAIMS:

Please cancel claims 1-37 and add the following new claims 38-74:

38. (New) Electromechanical component for actuating a vehicle parking brake of the type including a drum brake including two brake shoes and an expanding lock, said electromechanical component comprising:

an actuating unit connected to a power transmission element, wherein the actuating unit consists of an electric motor and a reduction gear arranged between the electric motor and the power transmission element, wherein a rotor of the electric motor is shaped in hollow or tubular fashion and radially encompasses a reduction gear.

39. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 38,wherein the reduction gear is realized in the form of a spindle drive, the spindle of which forms the power transmission element, and a spindle nut of which is connected to the rotor in power-transmitting fashion.

40. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 39, wherein the spindle drive is realized in self-locking fashion.

41. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 39, wherein the spindle drive is not realized in self-locking fashion and cooperates with a locking mechanism.

42. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 41, wherein the spindle drive consists of a ball screw.

43. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 41, wherein the locking mechanism is formed by an armature of a magnetic clamp which can be displaced axially to the rotor and, in a currentless state of the electric motor, engaged with a friction surface that cooperates with the rotor by means of a spring.

44. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 43, wherein the armature is actuated by the magnetic leakage flux generated by the stator of the electric motor.

45. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 41, wherein the locking mechanism is formed by an electromagnetic braking device that cooperates with the rotor.

46. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 39, wherein the spindle is arranged such that it is secured from rotating.

47. (New) Electromechanical component for actuating a vehicle parking brake according Claim 38, further including a housing surrounding the actuating unit wherein said housing is realized in the form of a deep-drawn sheet metal part.

48. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 46, wherein the housing contains an axial tubular extension that protrudes into an interior of the rotor and accommodates the end of the spindle which faces the expanding lock such that the spindle end is secured from rotating.

49. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 48, wherein the extension has a polygonal inner profile that cooperates with the correspondingly shaped end of the spindle.

50. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 38, wherein the rotor is realized in the form of a tubular deep-drawn sheet metal part.

51. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 50, wherein the rotor forms the spindle nut of the spindle drive.

52. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 50, further including a ball screw nut is pressed into the rotor.

53. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 50, further including permanent magnet segments bonded onto the surface of the rotor.

54. (New) Electromechanical component for actuating a vehicle parking brake according to one Claim 38, further including a fixed bearing that is held in the housing of the actuating unit by rolling up the rotor end wherein said fixed bearing supports an end of said rotor.

55. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 38, further including a bearing cover that is fixed by rolling up the housing, wherein said bearing cover encloses an end of said housing.

56. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 55, wherein the bearing cover accommodates a movable bearing, in which the other end of the rotor is arranged.

57. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 55, wherein the bearing cover limits a hollow space that accommodates an electronic circuit for controlling the electric motor.

58. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 55, wherein the bearing cover consists of plastic.

59. (New) Electromechanical component for actuating a vehicle parking brake according to of Claim 55, further including a cable guide located in the bearing cover, wherein a preferably extrusion-coated connecting line extends through said cable guide.

60. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 38, further including a steel cable line arranged between the power transmission element and the expanding lock.

61. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 60, wherein the steel cable line contains a steel strand as well as a plastic sheathing that surrounds the steel strand.

62. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 60, wherein the steel cable line is pressed into the power transmission element.

63. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 62, wherein the steel cable line is pressed into a conical bore in the power transmission element.

64. (New) Electromechanical component for actuating a vehicle parking brake according to one of Claim 60, wherein the end of the steel cable line which faces the expanding lock is provided with at least one of a drawbar eye or a nipple

65. (New) Electromechanical component for actuating a vehicle parking brake according to one of Claim 60, wherein the steel cable line is protected by a bellows, wherein the end of the bellows which faces away from the expanding lock is

realized in the shape of an O-ring and is accommodated by a preferably circular depression provided in the housing of the actuating unit.

66. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 65, wherein the end of the bellows which faces the expanding lock is welded to the plastic sheathing of the steel cable line which surrounds the steel strand, preferably by means of ultrasonic welding.

67. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 38, wherein the electric motor is realized in the form of an electronically commutated electric motor.

68. (New) Electromechanical component for actuating a vehicle parking brake according to one of Claim 38, wherein the electric motor is realized in the form of a DC brush motor.

69. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 38, wherein a planetary gear is functionally arranged between the rotor and the reduction gear.

70. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 69, wherein the rotor is realized in the form of a sun wheel of the planetary gear.

71. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 69, wherein the planet wheels of the planetary gear cooperate with a ring gear formed on the inner side of the housing of the actuating unit.

72. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 71, wherein the planet wheels are arranged on a radial web of a spindle nut, and wherein the spindle nut cooperates with a radial bearing that is supported on the housing of the actuating unit within the region that is adjacent to the web.

73. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 38, wherein the housing of the actuating unit is provided with a constriction that serves for mounting the actuating unit by rolling up the edges of a cutout in a dirt trap that protects the drum brake from the admission of dirt.

74. (New) Electromechanical component for actuating a vehicle parking brake according to Claim 38, wherein the drum brake is realized in the form of a dual power brake.

REMARKS

Prior to a formal examination of the above-identified application, acceptance of the new claims and the enclosed substitute specification as well as a new drawing is respectfully requested. The substitute specification, the new claims and the new drawing are submitted to conform this case to the formal requirements of U.S. Patent Office practice.

STATEMENT

The undersigned, an attorney registered to practice before the office, hereby states that the enclosed substitute specification and the new drawing contain no new subject matter.

Respectfully submitted,

By:

Joseph V. Coppola, Sr.
Reg. No. 33,373
Rader Fishman & Grauer PLLC
Suite 140
1533 N. Woodward Avenue
Bloomfield Hills, MI 48304
(248) 594-0650

CERTIFICATE OF MAILING

I hereby certify that the enclosed Preliminary Amendment is being deposited with the United States Postal Service on the date shown below with sufficient postage as Express Mail Post Office to Addressee mailing Label Number EL134825407US in an envelope addressed to the: Commissioner of Patents and Trademarks, Washington, D.C. 20231.

Date: December 7, 1998 By:

R0042528

SUBSTITUTE SPECIFICATION: CLEAN COPY

AP8985

ELECTROMECHANICALLY ACTUATED PARKING BRAKE FOR MOTOR VEHICLES

Technical Field

The invention pertains to vehicle parking brakes and more particularly relates to an electromechanically actuated parking brake for motor vehicles.

Background of the Invention

An electromechanically actuated parking brake of this type is, for example, known from German Offenlegungsschrift DE 4,129,919 A1. Among other things, the aforementioned publication discloses a combination of an electric motor that acts as a motor operator and a drum brake. In this case, the electric motor is arranged in the vicinity of the associated wheel brake or forms one structural unit together with the wheel brake. However, this prior state of the art does not contain any reference regarding the specific design of the actuating unit.

Consequently, the present invention is based on the objective of proposing an electromechanically actuated parking brake of the initially mentioned type which has a high functional reliability and a small size, in particular, a small axial length of the actuating unit.

According to the invention, this objective is attained due to the fact that the rotor of the electric motor is realized in hollow or tubular fashion and radially encompasses the reduction gear.

According to one preferred embodiment of the invention, it is proposed that the reduction gear is realized in the form of a spindle drive, the spindle of which forms the power transmission element, and the spindle nut of which is connected to the rotor in power-transmitting fashion.

According to advantageous additional developments of the invention, the spindle drive may be realized] in a self-locking fashion. The first-mentioned solution automatically fulfills the legal requirements regarding currentless mechanical locking of the parking brake. However, an additional mechanical or electromechanical locking mechanism needs to be provided for spindle drives that are not realized in self-locking fashion, e.g., a ball screw.

In one particularly advantageous embodiment, the locking mechanism is formed by the armature of a magnetic clamp which can be displaced axially to the rotor. In the currentless state of the electric motor, this armature can be engaged with a friction disc by means of a spring,

wherein said friction disc cooperates with the rotor. In this case, the armature is preferably actuated by the magnetic leakage flux generated by the stator of the electric motor.

Another option for realizing the aforementioned locking mechanism consists of designing it in the form of an electromagnetic braking device that cooperates with the rotor.

Optimal power transmission between the power transmission element and the expanding lock is, according to another advantageous additional development of the invention, attained due to the fact that the spindle which forms the power transmission element is arranged such that it is secured from rotating.

One embodiment of the invention which can be inexpensively manufactured is characterized by the fact that the housing of the electric motor is realized in the form of a deep-drawn sheet metal part.

In order to sensibly realize the aforementioned arrangement for securing the spindle from rotating, another advantageous embodiment of the invention is characterized by the fact that the housing contains an axial tubular extension which protrudes into the interior of the rotor and accommodates the end of the spindle which faces the expanding lock such that it is secured from rotating, wherein said extension preferably has a polygonal inner profile that cooperates with the correspondingly shaped end of the spindle.

In another embodiment of the invention which can be inexpensively manufactured, the rotor is realized in the form of a tubular sheet metal part that forms the spindle nut of the spindle drive. In an alternative embodiment, a ball screw nut is pressed into the rotor.

In addition, it is proposed that the rotor is arranged in a fixed bearing on one end, wherein said fixed bearing is held in the housing of the electric motor by rolling up the rotor end.

It is also quite advantageous that the housing of the electric motor is closed by means of a bearing cover on its end that faces away from the drum brake. This bearing cover is fixed to the housing by rolling up. In this case, the bearing cover preferably accommodates a movable bearing, in which the other end of the rotor is arranged.

The bearing cover advantageously limits a hollow space that serves for accommodating an electronic circuit for controlling the electric motor. Due to this measure, the electronic circuit for controlling the motor is integrated into the motor housing.

In another embodiment of the invention which can be inexpensively manufactured, the bearing cover consists of plastic and contains a cable guide through which a preferably extrusion-coated connecting line extends.

A flawlessly functioning power transmission between the actuating unit and the expanding lock of the drum brake is, according to the invention, obtained by utilizing a short, flexible steel cable line that is pressed or crimped into the power transmission element and provided with a drawbar eye on its end that faces the expanding lock. In this case, the steel cable line preferably consists of a steel strand that is provided with a plastic sheathing. The steel cable line is provided with a bellows so as to prevent the admission of dirt into the electric motor, wherein the end of the bellows which faces away from the drawbar eye is realized in the shape of an O-ring and accommodated by a preferably circular depression arranged in the housing of the electric motor. The end of the bellows which faces the expanding lock is welded to the plastic sheathing, in particular, by means of ultrasonic welding, such that the bellows is reliably sealed and protected from the admission of dirt or moisture. The motor interior is reliably protected from moisture by crimping the end of the steel cable on the motor side into a conically extending blind bore of the power transmission element.

Electronically commutated DC electric motors or DC brush motors may, in particular, be considered as driving motors for the actuating unit of the parking brake according to the invention. These motor types are particularly suitable for generating high torques from a standstill.

In order to attain a significant reduction of the required driving torque to be generated by the electric motor, a planetary gear is functionally arranged between the rotor and the reduction gear, wherein the sun wheel of said planetary gear is realized on one end of the rotor. The planet wheels preferably cooperate with an internal ring gear formed on the inner side of the housing of the electric motor. In this case, it is particularly practical if the planet wheels are arranged on a radial collar of the spindle nut that cooperates with a radial bearing supported on the housing of the electric motor within its region that is situated adjacent to the collar.

An optimal and space-saving mounting of the actuating unit is, according to another advantageous embodiment of the invention, obtained by providing the housing of the electric motor with a constriction that serves for mounting the actuating unit by means of rolling up in a cutout of

a dirt trap that protects the drum brake from the admission of dirt. The drum brake is preferably realized in the form of a dual power brake.

Brief Description of the Drawings

Figure 1 is a first embodiment of the electromechanically actuated parking brake according to the invention in the form of an axial section.

Figure 2 is a second embodiment of the object of the invention, namely in the form of a representation that corresponds to Figure 1.

Figure 3 is a third embodiment of the object of the invention, namely in the form of a representation that corresponds to Figure 1.

Detailed Description of the Preferred Embodiments

Now referring to Figure 1, the electromechanically actuated parking brake according to the invention which is shown in the figures essentially consists of a generally known drum brake, preferably a dual power brake 1, and an actuating unit 2. The housing 3 of the actuating unit which is realized in the form of a sheet metal part is mounted in a cutout of a dirt trap 4 that protects the drum brake 1 from the admission of dirt and is not illustrated in detail in the figure. For this purpose, the housing 3 is provided with a constriction 26 that allows the rolling up of the edge region of the dirt trap 4 which limits the cutout. The actuating or driving unit 2 is connected to an expanding lock 5 in power-transmitting fashion. The expanding lock allows a mechanical actuation of two brake shoes, one of which is illustrated in the figure and identified by the reference symbol 6. When the expanding lock is actuated, the brake shoes 6 come in contact with a brake drum 7.

The actuating unit 2 consists of an electric motor 8, a reduction gear 9 and a power transmission element 10 that is coupled to the aforementioned expanding lock 5 by way of a steel cable line 14. The steel cable line 14 that preferably consists of a steel strand and a plastic sheathing that surrounds the steel strand is provided with a drawbar eye or a nipple on its end that faces the expanding lock 5. Its other end is pressed or crimped into the power transmission element 10 or 16, respectively. An elastic bellows 15 that is arranged between the electric motor 8 and the expanding lock 5 preferably serves for protecting the electric motor 8 and the steel cable line 14 from the admission of dirt. The edge region of said bellows which is assigned to the housing 3 is

realized in the shape of an O-ring and is arranged in a circular depression 25 in the housing 3, namely in such a way that it is clamped between the housing 3 and a carrier plate 27. The end of the bellows which faces the expanding lock 5 is welded to the plastic sheathing, in particular, by means of ultrasonic welding. Consequently, the steel cable line 14 is reliably sealed and protected from dirt and moisture.

The electric motor 8 shown in the embodiment according to Figure 1 is realized in the form of an electronically commutated motor, wherein said motor may also be realized in the form of a DC brush motor. The stator of the electric motor 8 which is identified by the reference symbol 11 is immovably arranged in the housing 3 that is of deep-drawn sheet metal, wherein the rotor 12 is preferably realized in the form of a tubular sheet metal part, onto the surface of which permanent magnet segments 13 are bonded. In this case, the end of the rotor 12 which faces the drum 7 is arranged in a fixed bearing 18 held in the housing 3 by rolling up the rotor end. A movable bearing 19 supports the end of the rotor which faces away from the drum 7. The reduction gear 9 is preferably arranged coaxially to the rotor 12 and radially encompassed by said rotor in this case.

Figure 1 also shows that the reduction gear 9 is realized in the form of a self-locking spindle drive, the spindle 16 of which forms the power transmission element 10, and the spindle nut 17 of which is formed by a tubular part that is arranged coaxially to the rotor 12 and preferably realized integrally with the rotor 12. An axial tubular extension 20 of the housing 3 which preferably protrudes into the interior of the rotor 12 serves for securing the spindle 16 from rotating. The aforementioned extension 20 has a polygonal inner profile that cooperates with the correspondingly shaped end of the spindle 16.

The housing 3 of the actuating unit 2 is closed with a bearing cover 21 that is fixed in position by rolling up the edge region of the housing 3. The bearing cover 21 which preferably consists of a suitable plastic material and accommodates the aforementioned movable bearing 19 limits annular hollow spaces 22 in the housing 3 of the actuating unit 2. Not-shown electronic components that serve for controlling the electric motor 8 may, for example, be arranged in this hollow space. In addition, a cable guide 23 is provided in the bearing cover 21. A preferably extrusion-coated connecting line 24 that leads to the stator 11 of the electric motor 8 extends through the aforementioned cable guide.

In the embodiment of the invention which is shown in Figure 2, the reduction gear 9 described previously with reference to Figure 1 is realized in the form of a spindle drive that is not self-locking or a ball screw 28, 29, 30, respectively. The ball screw consists of a threaded spindle 28 as well as a ball screw nut 29 that is preferably pressed into the rotor 12. The rotational movement of this ball screw nut is converted into a translational movement of the threaded spindle 28 by means of rows of balls 30. In order to prevent a loosening of the parking brake according to the invention, the ball screw 28-30 cooperates with a locking mechanism 31 that is formed by an armature 33 of a magnetic clamp in the embodiment shown. This magnetic clamp is actuated by the magnetic leakage flux generated by the stator 11 of the electric motor 8. The armature 33 that is preferably realized in cup-shaped fashion is arranged on the rotor 12 such that it is secured from rotating relative to said rotor. However, this armature can be axially displaced on the rotor and is pressed against a friction surface 34 formed on the aforementioned bearing cover 21 by means of a plate spring 32, while in the currentless state of the stator 11. Once the electric motor 8 receives a current, the armature 33 is retracted against the force of the plate spring 32 due to the effect of the leakage flux generated by the stator 11, i.e., the armature is disengaged from the friction surface 34 such that the rotor 12 is able to freely rotate and drive the armature 33. However, the scope of the invention also includes an embodiment in which an electromagnetic braking device is provided which cooperates with the rotor 12 and is actuated independently of the stator 11 receiving a current.

Figure 3 shows one additional embodiment of the actuating unit 2 used in the invention. In this case, the electric motor 8 is realized in the form of a DC brush motor, the stator of which is formed by permanent magnet segments 36 arranged in the housing 35 of the actuating unit. The rotor that receives a current by way of a collector 37 is formed by a tube 39 that is supported at two points and carries an armature winding 38. The end region of this tube which faces the drum not shown is realized in the form of a sun wheel 40 of a planetary gear that is identified by the reference symbol 50 and is functionally arranged between the electric motor 8 and a reduction gear 51. The design of the reduction gear 51 corresponds to that of the spindle drive shown in Figure 1, i.e., a detailed description of this reduction gear is not required. The sun wheel 40 drives planet wheels 41 that revolve in a ring gear 42. This ring gear is machined into the inner side of the housing 35 and consequently forms part of said housing. The planet wheels 41 are carried by a radial web 43

that is arranged on the end of the tubular threaded nut 44 for driving the spindle 45 which faces the [not-shown] drum brake. The web 43 is arranged in the housing 35 in a main bearing 46, i.e., it serves as the drive of the planetary gear 50. The entire driving or actuating unit is encapsulated, i.e., protected from the admission of dirt and moisture by means of seals 47 and 48.

The steel cable line 14 is pressed or crimped into the power transmission element that is realized in the form of a spindle 45 in order to additionally seal the electric motor 8, in particular, from the admission of moisture. For this purpose, a conical blind bore 60 is provided inside the spindle 45. The end of the steel cable line 14 is accommodated in this blind bore and secured from separating by means of crimping. In this case, the steel cable line with its plastic sheeting is inserted in the blind bore of the spindle during the crimping process, namely in such a way that a seal that is impermeable to moisture is formed between the plastic sheathing and the conical bore surface. Any moisture that might be present in the steel cable line 14, i.e., between the steel strand and the cable sheathing, consequently cannot be admitted into the interior of the electric motor.

ELECTROMECHANICALLY ACTUATED PARKING BRAKE FOR MOTOR VEHICLES

Abstract of the Disclosure

The invention proposes an electromechanically actuated parking brake for motor vehicles that consists of a drum brake and an actuating unit for actuating the drum brake, wherein the drum brake contains two brake shoes and an expanding lock that cooperates with the actuating unit by way of a power transmission element, and wherein the actuating unit is formed by an electric motor and a reduction gear that is arranged between the electric motor and the power transmission element. In order to reduce the axial length of the actuating unit, the invention proposes that the rotor of the electric motor is respectively realized in hollow or tubular fashion and radially encompasses the reduction gear.

SUBSTITUTE SPECIFICATION: MARKED UP COPY

[Code: 1991-66366

Ref. No.: 64098-612 (AP8985)]

ELECTROMECHANICALLY ACTUATED PARKING BRAKE FOR MOTOR VEHICLES

Technical Field

The invention pertains to vehicle parking brakes and more particularly relates to an electromechanically actuated parking brake for motor vehicles [which consists of a drum brake and an actuating unit for actuating the drum brake, wherein the drum brake contains two brake shoes and a expanding lock that cooperates with the actuating unit via a power transmission element, and wherein the actuating unit consists of an electric motor and a reduction gear arranged between the electric motor and the power transmission element].

Background of the Invention

An electromechanically actuated parking brake of this type is, for example, known from German Offenlegungsschrift DE 4,129,919 A1. Among other things, the aforementioned publication discloses a combination of an electric motor that acts as a motor operator and a drum brake. In this case, the electric motor is arranged in the vicinity of the associated wheel brake or forms one structural unit together with the wheel brake. However, this prior state of the art does not contain any reference regarding the [concrete] specific design of the actuating unit.

Consequently, the present invention is based on the objective of proposing an electromechanically actuated parking brake of the initially mentioned type which has a high functional reliability and a small size, in particular, a small axial length of the actuating unit.

According to the invention, this objective is attained due to the fact that the rotor of the electric motor is realized in hollow or tubular fashion and radially encompasses the reduction gear.

According to one [concrete] preferred embodiment of the invention, it is proposed that the reduction gear is realized in the form of a spindle drive, the spindle of which forms the power transmission element, and the spindle nut of which is connected to the rotor in power-transmitting fashion.

According to advantageous additional developments of the invention, the spindle drive may be realized [either] in a self-locking fashion [or not]. The first-mentioned solution automatically fulfills the legal requirements regarding currentless mechanical locking of the parking brake. However, an additional mechanical or electromechanical locking mechanism needs to be provided for spindle drives that are not realized in self-locking fashion, e.g., a ball screw.

In one particularly advantageous embodiment, the locking mechanism is formed by the armature of a magnetic clamp which can be displaced axially to the rotor. In the currentless state of the electric motor, this armature can be engaged with a friction disc by means of a spring, wherein said friction disc cooperates with the rotor. In this case, the armature is preferably actuated by the magnetic leakage flux generated by the stator of the electric motor.

Another option for realizing the aforementioned locking mechanism consists of designing it in the form of an electromagnetic braking device that cooperates with the rotor.

Optimal power transmission between the power transmission element and the expanding lock is, according to another advantageous additional development of the invention, attained due to the fact that the spindle which forms the power transmission element is arranged such that it is secured from rotating.

One embodiment of the invention which can be inexpensively manufactured is characterized by the fact that the housing of the electric motor is realized in the form of a deep-drawn sheet metal part.

In order to sensibly realize the aforementioned arrangement for securing the spindle from rotating, another advantageous embodiment of the invention is characterized by the fact that the housing contains an axial tubular extension which protrudes into the interior of the rotor and accommodates the end of the spindle which faces the expanding lock such that it is secured from rotating, wherein said extension preferably has a polygonal inner profile that cooperates with the correspondingly shaped end of the spindle.

In another embodiment of the invention which can be inexpensively manufactured, the rotor is realized in the form of a tubular sheet metal part that forms the spindle nut of the spindle drive. In an alternative embodiment, a ball screw nut is pressed into the rotor.

In addition, it is proposed that the rotor is arranged in a fixed bearing on one end, wherein said fixed bearing is held in the housing of the electric motor by rolling up the rotor end.

It is also quite advantageous that the housing of the electric motor is closed by means of a bearing cover on its end that faces away from the drum brake. This bearing cover is fixed to the housing by rolling up. In this case, the bearing cover preferably accommodates a movable bearing, in which the other end of the rotor is arranged.

The bearing cover advantageously limits a hollow space that serves for accommodating an electronic circuit for controlling the electric motor. Due to this measure, the electronic circuit for controlling the motor is integrated into the motor housing.

In another embodiment of the invention which can be inexpensively manufactured, the bearing cover consists of plastic and contains a cable guide through which a preferably extrusion-coated connecting line extends.

A flawlessly functioning power transmission between the actuating unit and the expanding lock of the drum brake is, according to the invention, obtained by utilizing a short, flexible steel cable line that is pressed or crimped into the power transmission element and provided with a drawbar eye on its end that faces the expanding lock. In this case, the steel cable line preferably consists of a steel strand that is provided with a plastic sheathing. The steel cable line is provided with a bellows so as to prevent the admission of dirt into the electric motor, wherein the end of the bellows which faces away from the drawbar eye is realized in the shape of an O-ring and accommodated by a preferably circular depression arranged in the housing of the electric motor. The end of the bellows which faces the expanding lock is welded to the plastic sheathing, in particular, by means of ultrasonic welding, such that the bellows is reliably sealed and protected from the admission of dirt or moisture. The motor interior is reliably protected from moisture by crimping the end of the steel cable on the motor side into a conically extending blind bore of the power transmission element.

Electronically commutated DC electric motors or DC brush motors may, in particular, be considered as driving motors for the actuating unit of the parking brake according to the invention. These motor types are particularly suitable for generating high torques from a standstill.

In order to attain a significant reduction of the required driving torque to be generated by the electric motor, a planetary gear is functionally arranged between the rotor and the reduction gear, wherein the sun wheel of said planetary gear is realized on one end of the rotor. The planet wheels preferably cooperate with an internal ring gear formed on the inner side of the housing of

the electric motor. In this case, it is particularly practical if the planet wheels are arranged on a radial collar of the spindle nut that cooperates with a radial bearing supported on the housing of the electric motor within its region that is situated adjacent to the collar.

An optimal and space-saving mounting of the actuating unit is, according to another advantageous embodiment of the invention, obtained by providing the housing of the electric motor with a constriction that serves for mounting the actuating unit by means of rolling up in a cutout of a dirt trap that protects the drum brake from the admission of dirt. The drum brake is preferably realized in the form of a dual power brake.

[Additional characteristics and advantages of the electromechanically actuated parking brake according to the invention are disclosed in the following description of three embodiments which refers to the enclosed figures. The figures show:]

Brief Description of the Drawings

Figure 1[,] is a first embodiment of the electromechanically actuated parking brake according to the invention in the form of an axial section[;] .

Figure 2[,] is a second embodiment of the object of the invention, namely in the form of a representation that corresponds to Figure 1[, and] a

Figure 3[,] is a third embodiment of the object of the invention, namely in the form of a representation that corresponds to Figure 1.

Detailed Description of the Preferred Embodiments

[The] Now referring to Figure 1, the electromechanically actuated parking brake according to the invention which is shown in the figures essentially consists of a generally known drum brake, preferably a dual power brake 1, and an actuating unit 2. The housing 3 of the actuating unit which is realized in the form of a sheet metal part is mounted in a cutout of a dirt trap 4 that protects the drum brake 1 from the admission of dirt and is not illustrated in detail in the figure. For this purpose, the housing 3 is provided with a constriction 26 that allows the rolling up of the edge region of the dirt trap 4 which limits the cutout. The actuating or driving unit 2 is connected to an expanding lock 5 in power-transmitting fashion. The expanding lock allows a mechanical actuation

of two brake shoes, one of which is illustrated in the figure and identified by the reference symbol 6. When the expanding lock is actuated, the brake shoes 6 come in contact with a brake drum 7.

The actuating unit 2 consists of an electric motor 8, a reduction gear 9 and a power transmission element 10 that is coupled to the aforementioned expanding lock 5[via] by way of a steel cable line 14. The steel cable line 14 that preferably consists of a steel strand and a plastic sheathing that surrounds the steel strand is provided with a drawbar eye or a nipple on its end that faces the expanding lock 5. Its other end is pressed or crimped into the power transmission element 10 or 16, respectively. An elastic bellows 15 that is arranged between the electric motor 8 and the expanding lock 5 preferably serves for protecting the electric motor 8 and the steel cable line 14 from the admission of dirt. The edge region of said bellows which is assigned to the housing 3 is realized in the shape of an O-ring and is arranged in a circular depression 25 in the housing 3, namely in such a way that it is clamped between the housing 3 and a carrier plate 27. The end of the bellows which faces the expanding lock 5 is welded to the plastic sheathing, in particular, by means of ultrasonic welding. Consequently, the steel cable line 14 is reliably sealed and protected from dirt and moisture.

The electric motor 8 shown in the embodiment according to Figure 1 is realized in the form of an electronically commutated motor, wherein said motor may also be realized in the form of a DC brush motor. The stator of the electric motor 8 which is identified by the reference symbol 11 is immovably arranged in the housing 3 that is of deep-drawn sheet metal, wherein the rotor 12 is preferably realized in the form of a tubular sheet metal part, onto the surface of which permanent magnet segments 13 are bonded. In this case, the end of the rotor 12 which faces the drum 7 is arranged in a fixed bearing 18 held in the housing 3 by rolling up the rotor end. A movable bearing 19 supports the end of the rotor which faces away from the drum 7. The reduction gear 9 is preferably arranged coaxially to the rotor 12 and radially encompassed by said rotor in this case.

Figure 1 also shows that the reduction gear 9 is realized in the form of a self-locking spindle drive, the spindle 16 of which forms the power transmission element 10, and the spindle nut 17 of which is formed by a tubular part that is arranged coaxially to the rotor 12 and preferably realized integrally with the rotor 12. An axial tubular extension 20 of the housing 3 which preferably protrudes into the interior of the rotor 12 serves for securing the spindle 16 from rotating. The

aforementioned extension 20 has a polygonal inner profile that cooperates with the correspondingly shaped end of the spindle 16.

The housing 3 of the actuating unit 2 is closed with a bearing cover 21 that is fixed in position by rolling up the edge region of the housing 3. The bearing cover 21 which preferably consists of a suitable plastic material and accommodates the aforementioned movable bearing 19 limits annular hollow spaces 22 in the housing 3 of the actuating unit 2. Not-shown electronic components that serve for controlling the electric motor 8 may, for example, be arranged in this hollow space. In addition, a cable guide 23 is provided in the bearing cover 21. A preferably extrusion-coated connecting line 24 that leads to the stator 11 of the electric motor 8 extends through the aforementioned cable guide.

In the embodiment of the invention which is shown in Figure 2, the reduction gear 9 described previously with reference to Figure 1 is realized in the form of a spindle drive that is not self-locking or a ball screw 28, 29, 30, respectively. The ball screw consists of a threaded spindle 28 as well as a ball screw nut 29 that is preferably pressed into the rotor 12. The rotational movement of this ball screw nut is converted into a translational movement of the threaded spindle 28 by means of rows of balls 30. In order to prevent a loosening of the parking brake according to the invention, the ball screw 28-30 cooperates with a locking mechanism 31 that is formed by an armature 33 of a magnetic clamp in the embodiment shown. This magnetic clamp is actuated by the magnetic leakage flux generated by the stator 11 of the electric motor 8. The armature 33 that is preferably realized in cup-shaped fashion is arranged on the rotor 12 such that it is secured from rotating relative to said rotor. However, this armature can be axially displaced on the rotor and is pressed against a friction surface 34 formed on the aforementioned bearing cover 21 by means of a plate spring 32, while in the currentless state of the stator 11. Once the electric motor 8 receives a current, the armature 33 is retracted against the force of the plate spring 32 due to the effect of the leakage flux generated by the stator 11, i.e., the armature is disengaged from the friction surface 34 such that the rotor 12 is able to freely rotate and drive the armature 33. However, the scope of the invention also includes an embodiment in which an electromagnetic braking device is provided which cooperates with the rotor 12 and is actuated independently of the stator 11 [12] receiving a current.

Figure 3 shows one additional embodiment of the actuating unit 2 used in the invention. In this case, the electric motor 8 is realized in the form of a DC brush motor, the stator of which is formed by permanent magnet segments 36 arranged in the housing 35 of the actuating unit. The rotor that receives a current [via] by way of a collector 37 is formed by a tube 39 that is supported at two points and carries an armature winding 38. The end region of this tube which faces the [not-shown drum] drum not shown is realized in the form of a sun wheel 40 of a planetary gear that is identified by the reference symbol 50 and is functionally arranged between the electric motor 8 and a reduction gear 51. The design of the reduction gear 51 corresponds to that of the spindle drive shown in Figure 1, i.e., a detailed description of this reduction gear is not required. The sun wheel 40 drives planet wheels 41 that revolve in a ring gear 42. This ring gear is machined into the inner side of the housing 35 and consequently forms part of said housing. The planet wheels 41 are carried by a radial web 43 that is arranged on the end of the tubular threaded nut 44 for driving the spindle 45 which faces the [not-shown] drum brake. The web 43 is arranged in the housing 35 in a main bearing 46, i.e., it serves as the drive of the planetary gear 50. The entire driving or actuating unit is encapsulated, i.e., protected from the admission of dirt and moisture by means of seals 47 and 48.

The steel cable line 14 is pressed or crimped into the power transmission element that is realized in the form of a spindle 45 in order to additionally seal the electric motor 8, in particular, from the admission of moisture. For this purpose, a conical blind bore 60 is provided inside the spindle 45. The end of the steel cable line 14 is accommodated in this blind bore and secured from separating by means of crimping. In this case, the steel cable line with its plastic sheeting is inserted in the blind bore of the spindle during the crimping process, namely in such a way that a seal that is impermeable to moisture is formed between the plastic sheathing and the conical bore surface. Any moisture that might be present in the steel cable line 14, i.e., between the steel strand and the cable sheathing, consequently cannot be admitted into the interior of the electric motor.

[Abstract]

ELECTROMECHANICALLY ACTUATED PARKING BRAKE FOR MOTOR VEHICLES

Abstract of the Disclosure

The invention proposes an electromechanically actuated parking brake for motor vehicles that consists of a drum brake and an actuating unit for actuating the drum brake, wherein the drum brake contains two brake shoes and an expanding lock that cooperates with the actuating unit [via] by way of a power transmission element, and wherein the actuating unit is formed by an electric motor and a reduction gear that is arranged between the electric motor and the power transmission element. In order to reduce the axial length of the actuating unit, the invention proposes that the rotor [(12)] of the electric motor [(8)] is respectively realized in hollow or tubular fashion and radially encompasses the reduction gear [(9)].

Code: 1991-66366
Ref. No.: 64098-612 (AP8985)

ELECTROMECHANICALLY ACTUATED PARKING BRAKE FOR MOTOR VEHICLES

The invention pertains to an electromechanically actuated parking brake for motor vehicles which consists of a drum brake and an actuating unit for actuating the drum brake, wherein the drum brake contains two brake shoes and a expanding lock that cooperates with the actuating unit via a power transmission element, and wherein the actuating unit consists of an electric motor and a reduction gear arranged between the electric motor and the power transmission element.

An electromechanically actuated parking brake of this type is, for example, known from German Offenlegungsschrift DE 4,129,919 A1. Among other things, the aforementioned publication discloses a combination of an electric motor that acts as a motor operator and a drum brake. In this case, the electric motor is arranged in the vicinity of the associated wheel brake or forms one structural unit together with the wheel brake. However, this prior state of the art does not contain any reference regarding the concrete design of the actuating unit.

Consequently, the present invention is based on the objective of proposing an electromechanically actuated parking brake of the initially mentioned type which has a high functional reliability and a small size, in particular, a small axial length of the actuating unit.

According to the invention, this objective is attained due to the fact that the rotor of the electric motor is realized in hollow or tubular fashion and radially encompasses the reduction gear.

According to one concrete embodiment of the invention, it is proposed that the reduction gear is realized in the form of a spindle drive, the spindle of which forms the power transmission element, and the spindle nut of which is connected to the rotor in power-transmitting fashion.

According to advantageous additional developments of the invention, the spindle drive may be realized either in self-locking fashion or not. The first-mentioned solution automatically fulfills the legal requirements regarding currentless mechanical locking of the parking brake.

However, an additional mechanical or electromechanical locking mechanism needs to be provided for spindle drives that are not realized in self-locking fashion, e.g., a ball screw.

In one particularly advantageous embodiment, the locking mechanism is formed by the armature of a magnetic clamp which can be displaced axially to the rotor. In the currentless state of the electric motor, this armature can be engaged with a friction disc by means of a spring, wherein said friction disc cooperates with the rotor. In this case, the armature is preferably actuated by the magnetic leakage flux generated by the stator of the electric motor.

Another option for realizing the aforementioned locking mechanism consists of designing it in the form of an electromagnetic braking device that cooperates with the rotor.

Optimal power transmission between the power transmission element and the expanding lock is, according to another advantageous additional development of the invention, attained due to the fact that the spindle which forms the power transmission element is arranged such that it is secured from rotating.

One embodiment of the invention which can be inexpensively manufactured is characterized by the fact that the housing of the electric motor is realized in the form of a deep-drawn sheet metal part.

In order to sensibly realize the aforementioned arrangement for securing the spindle from rotating, another advantageous embodiment of the invention is characterized by the fact that the housing contains an axial tubular extension which protrudes into the interior of the rotor and accommodates the end of the spindle which faces the expanding lock such that it is secured from rotating, wherein said extension preferably has a polygonal inner profile that cooperates with the correspondingly shaped end of the spindle.

In another embodiment of the invention which can be inexpensively manufactured, the rotor is realized in the form of a tubular sheet metal part that forms the spindle nut of the spindle drive. In an alternative embodiment, a ball screw nut is pressed into the rotor.

In addition, it is proposed that the rotor is arranged in a fixed bearing on one end, wherein said fixed bearing is held in the housing of the electric motor by rolling up the rotor end.

It is also quite advantageous that the housing of the electric motor is closed by means of a bearing cover on its end that faces away from the drum brake. This bearing cover is fixed to the

housing by rolling up. In this case, the bearing cover preferably accommodates a movable bearing, in which the other end of the rotor is arranged.

The bearing cover advantageously limits a hollow space that serves for accommodating an electronic circuit for controlling the electric motor. Due to this measure, the electronic circuit for controlling the motor is integrated into the motor housing.

In another embodiment of the invention which can be inexpensively manufactured, the bearing cover consists of plastic and contains a cable guide through which a preferably extrusion-coated connecting line extends.

A flawlessly functioning power transmission between the actuating unit and the expanding lock of the drum brake is, according to the invention, obtained by utilizing a short, flexible steel cable line that is pressed or crimped into the power transmission element and provided with a drawbar eye on its end that faces the expanding lock. In this case, the steel cable line preferably consists of a steel strand that is provided with a plastic sheathing. The steel cable line is provided with a bellows so as to prevent the admission of dirt into the electric motor, wherein the end of the bellows which faces away from the drawbar eye is realized in the shape of an O-ring and accommodated by a preferably circular depression arranged in the housing of the electric motor. The end of the bellows which faces the expanding lock is welded to the plastic sheathing, in particular, by means of ultrasonic welding, such that the bellows is reliably sealed and protected from the admission of dirt or moisture. The motor interior is reliably protected from moisture by crimping the end of the steel cable on the motor side into a conically extending blind bore of the power transmission element.

Electronically commutated DC electric motors or DC brush motors may, in particular, be considered as driving motors for the actuating unit of the parking brake according to the invention. These motor types are particularly suitable for generating high torques from a standstill.

In order to attain a significant reduction of the required driving torque to be generated by the electric motor, a planetary gear is functionally arranged between the rotor and the reduction gear, wherein the sun wheel of said planetary gear is realized on one end of the rotor. The planet wheels preferably cooperate with an internal ring gear formed on the inner side of the housing of the electric motor. In this case, it is particularly practical if the planet wheels are arranged on a

radial collar of the spindle nut that cooperates with a radial bearing supported on the housing of the electric motor within its region that is situated adjacent to the collar.

An optimal and space-saving mounting of the actuating unit is, according to another advantageous embodiment of the invention, obtained by providing the housing of the electric motor with a constriction that serves for mounting the actuating unit by means of rolling up in a cutout of a dirt trap that protects the drum brake from the admission of dirt. The drum brake is preferably realized in the form of a dual power brake.

Additional characteristics and advantages of the electromechanically actuated parking brake according to the invention are disclosed in the following description of three embodiments which refers to the enclosed figures. The figures show:

Figure 1, a first embodiment of the electromechanically actuated parking brake according to the invention in the form of an axial section;

Figure 2, a second embodiment of the object of the invention, namely in the form of a representation that corresponds to Figure 1, and

Figure 3, a third embodiment of the object of the invention, namely in the form of a representation that corresponds to Figure 1.

The electromechanically actuated parking brake according to the invention which is shown in the figures essentially consists of a generally known drum brake, preferably a dual power brake 1, and an actuating unit 2. The housing 3 of the actuating unit which is realized in the form of a sheet metal part is mounted in a cutout of a dirt trap 4 that protects the drum brake 1 from the admission of dirt and is not illustrated in detail in the figure. For this purpose, the housing 3 is provided with a constriction 26 that allows the rolling up of the edge region of the dirt trap 4 which limits the cutout. The actuating or driving unit 2 is connected to a expanding lock 5 in power-transmitting fashion. The expanding lock allows a mechanical actuation of two brake shoes, one of which is illustrated in the figure and identified by the reference symbol 6. When the expanding lock is actuated, the brake shoes 6 come in contact with a brake drum 7.

The actuating unit 2 consists of an electric motor 8, a reduction gear 9 and a power transmission element 10 that is coupled to the aforementioned expanding lock 5 via a steel cable line 14. The steel cable line 14 that preferably consists of a steel strand and a plastic sheathing that surrounds the steel strand is provided with a drawbar eye or a nipple on its end that faces the expanding lock 5. Its other end is pressed or crimped into the power transmission element 10 or 16, respectively. An elastic bellows 15 that is arranged between the electric motor 8 and the expanding lock 5 preferably serves for protecting the electric motor 8 and the steel cable line 14 from the admission of dirt. The edge region of said bellows which is assigned to the housing 3 is realized in the shape of an O-ring and is arranged in a circular depression 25 in the housing 3, namely in such a way that it is clamped between the housing 3 and a carrier plate 27. The end of the bellows which faces the expanding lock 5 is welded to the plastic sheathing, in particular, by means of ultrasonic welding. Consequently, the steel cable line 14 is reliably sealed and protected from dirt and moisture.

The electric motor 8 shown in the embodiment according to Figure 1 is realized in the form of an electronically commutated motor, wherein said motor may also be realized in the form of a DC brush motor. The stator of the electric motor 8 which is identified by the reference symbol 11 is immovably arranged in the housing 3 that is of deep-drawn sheet metal, wherein the rotor 12 is preferably realized in the form of a tubular sheet metal part, onto the surface of which permanent magnet segments 13 are bonded. In this case, the end of the rotor 12 which faces the drum 7 is arranged in a fixed bearing 18 held in the housing 3 by rolling up the rotor end. A movable bearing 19 supports the end of the rotor which faces away from the drum 7. The reduction gear 9 is preferably arranged coaxially to the rotor 12 and radially encompassed by said rotor in this case.

Figure 1 also shows that the reduction gear 9 is realized in the form of a self-locking spindle drive, the spindle 16 of which forms the power transmission element 10, and the spindle nut 17 of which is formed by a tubular part that is arranged coaxially to the rotor 12 and preferably realized integrally with the rotor 12. An axial tubular extension 20 of the housing 3 which preferably protrudes into the interior of the rotor 12 serves for securing the spindle 16 from rotating. The aforementioned extension 20 has a polygonal inner profile that cooperates with the correspondingly shaped end of the spindle 16.

The housing 3 of the actuating unit 2 is closed with a bearing cover 21 that is fixed in position by rolling up the edge region of the housing 3. The bearing cover 21 which preferably consists of a suitable plastic material and accommodates the aforementioned movable bearing 19 limits annular hollow spaces 22 in the housing 3 of the actuating unit 2. Not-shown electronic components that serve for controlling the electric motor 8 may, for example, be arranged in this hollow space. In addition, a cable guide 23 is provided in the bearing cover 21. A preferably extrusion-coated connecting line 24 that leads to the stator 11 of the electric motor 8 extends through the aforementioned cable guide.

In the embodiment of the invention which is shown in Figure 2, the reduction gear 9 described previously with reference to Figure 1 is realized in the form of a spindle drive that is not self-locking or a ball screw 28, 29, 30, respectively. The ball screw consists of a threaded spindle 28 as well as a ball screw nut 29 that is preferably pressed into the rotor 12. The rotational movement of this ball screw nut is converted into a translational movement of the threaded spindle 28 by means of rows of balls 30. In order to prevent a loosening of the parking brake according to the invention, the ball screw 28-30 cooperates with a locking mechanism 31 that is formed by an armature 33 of a magnetic clamp in the embodiment shown. This magnetic clamp is actuated by the magnetic leakage flux generated by the stator 11 of the electric motor 8. The armature 33 that is preferably realized in cup-shaped fashion is arranged on the rotor 12 such that it is secured from rotating relative to said rotor. However, this armature can be axially displaced on the rotor and is pressed against a friction surface 34 formed on the aforementioned bearing cover 21 by means of a plate spring 32, while in the currentless state of the stator 11. Once the electric motor 8 receives a current, the armature 33 is retracted against the force of the plate spring 32 due to the effect of the leakage flux generated by the stator 11, i.e., the armature is disengaged from the friction surface 34 such that the rotor 12 is able to freely rotate and drive the armature 33. However, the scope of the invention also includes an embodiment in which an electromagnetic braking device is provided which cooperates with the rotor 12 and is actuated independently of the stator 12 [sic; 11] receiving a current.

Figure 3 shows one additional embodiment of the actuating unit 2 used in the invention. In this case, the electric motor 8 is realized in the form of a DC brush motor, the stator of which is formed by permanent magnet segments 36 arranged in the housing 35 of the actuating unit.

The rotor that receives a current via a collector 37 is formed by a tube 39 that is supported at two points and carries an armature winding 38. The end region of this tube which faces the not-shown drum is realized in the form of a sun wheel 40 of a planetary gear that is identified by the reference symbol 50 and is functionally arranged between the electric motor 8 and a reduction gear 51. The design of the reduction gear 51 corresponds to that of the spindle drive shown in Figure 1, i.e., a detailed description of this reduction gear is not required. The sun wheel 40 drives planet wheels 41 that revolve in a ring gear 42. This ring gear is machined into the inner side of the housing 35 and consequently forms part of said housing. The planet wheels 41 are carried by a radial web 43 that is arranged on the end of the tubular threaded nut 44 for driving the spindle 45 which faces the not-shown drum brake. The web 43 is arranged in the housing 35 in a main bearing 46, i.e., it serves as the drive of the planetary gear 50. The entire driving or actuating unit is encapsulated, i.e., protected from the admission of dirt and moisture by means of seals 47 and 48.

The steel cable line 14 is pressed or crimped into the power transmission element that is realized in the form of a spindle 45 in order to additionally seal the electric motor 8, in particular, from the admission of moisture. For this purpose, a conical blind bore 60 is provided inside the spindle 45. The end of the steel cable line 14 is accommodated in this blind bore and secured from separating by means of crimping. In this case, the steel cable line with its plastic sheeting is inserted in the blind bore of the spindle during the crimping process, namely in such a way that a seal that is impermeable to moisture is formed between the plastic sheathing and the conical bore surface. Any moisture that might be present in the steel cable line 14, i.e., between the steel strand and the cable sheathing, consequently cannot be admitted into the interior of the electric motor.

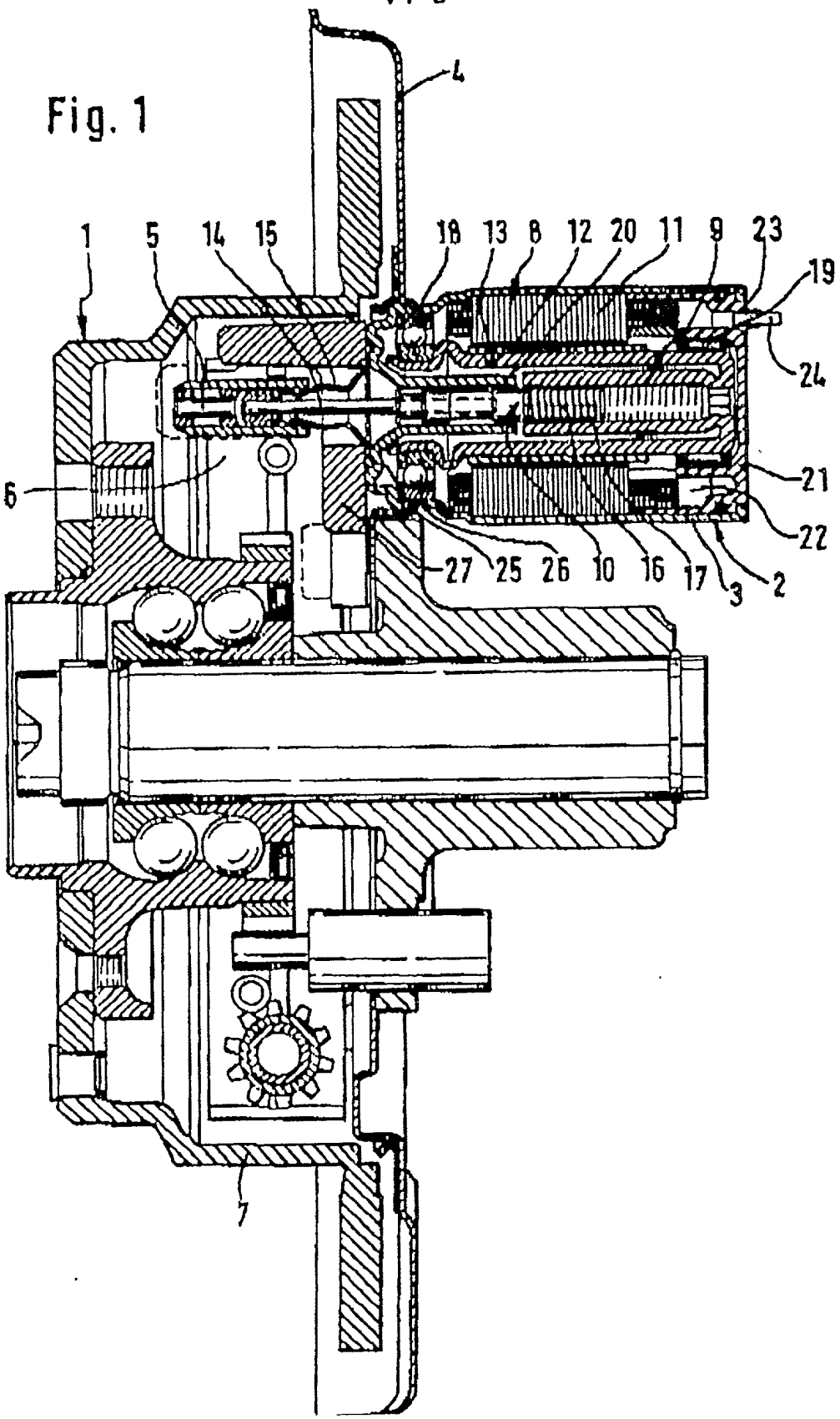
Abstract

Electromechanically Actuated Parking Brake for Motor Vehicles

The invention proposes an electromechanically actuated parking brake for motor vehicles that consists of a drum brake and an actuating unit for actuating the drum brake, wherein the drum brake contains two brake shoes and an expanding lock that cooperates with the actuating unit via a power transmission element, and wherein the actuating unit is formed by an electric motor and a reduction gear that is arranged between the electric motor and the power transmission element.

In order to reduce the axial length of the actuating unit, the invention proposes that the rotor (12) of the electric motor (8) is respectively realized in hollow or tubular fashion and radially encompasses the reduction gear (9).

Fig. 1



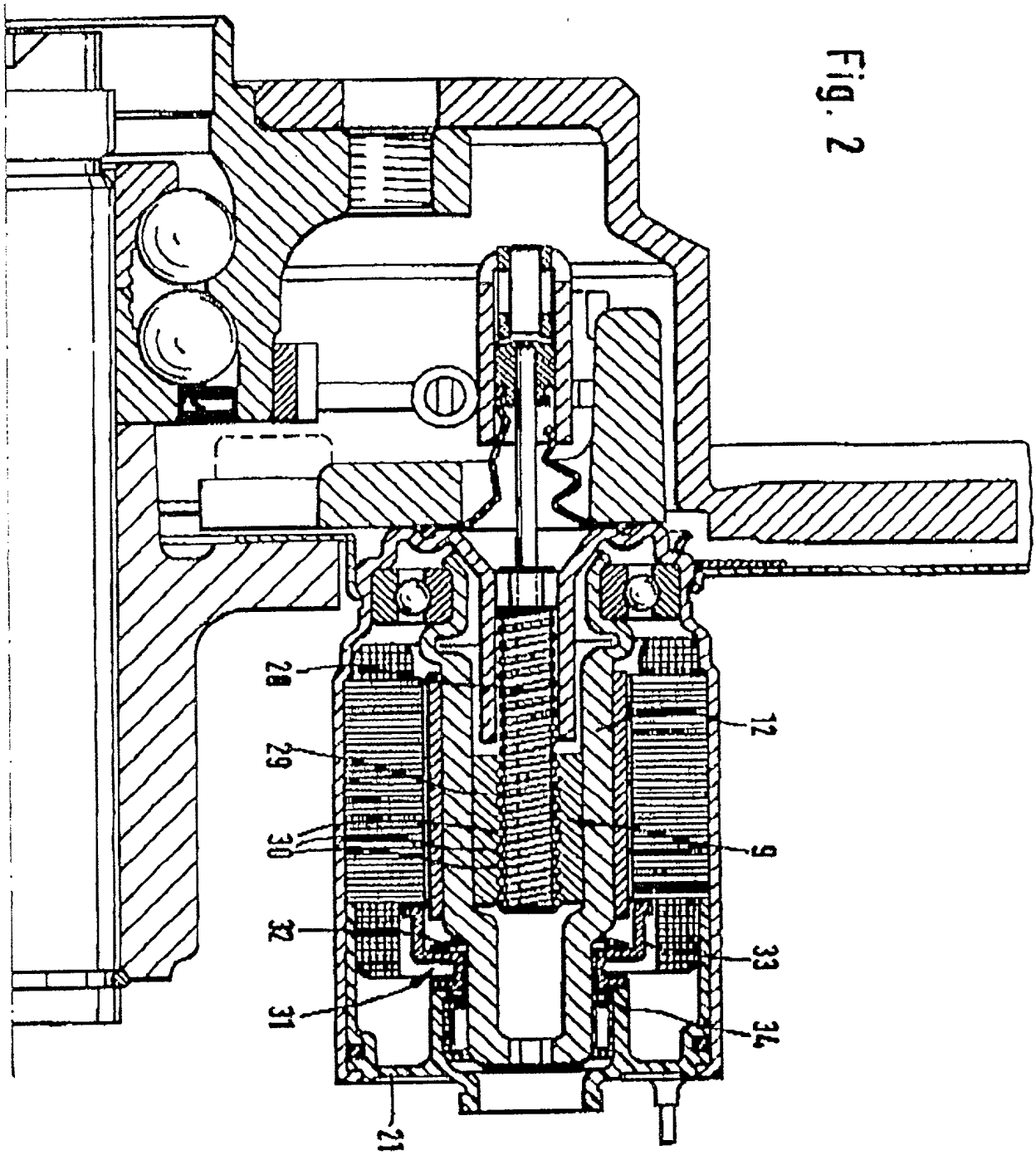


Fig. 2

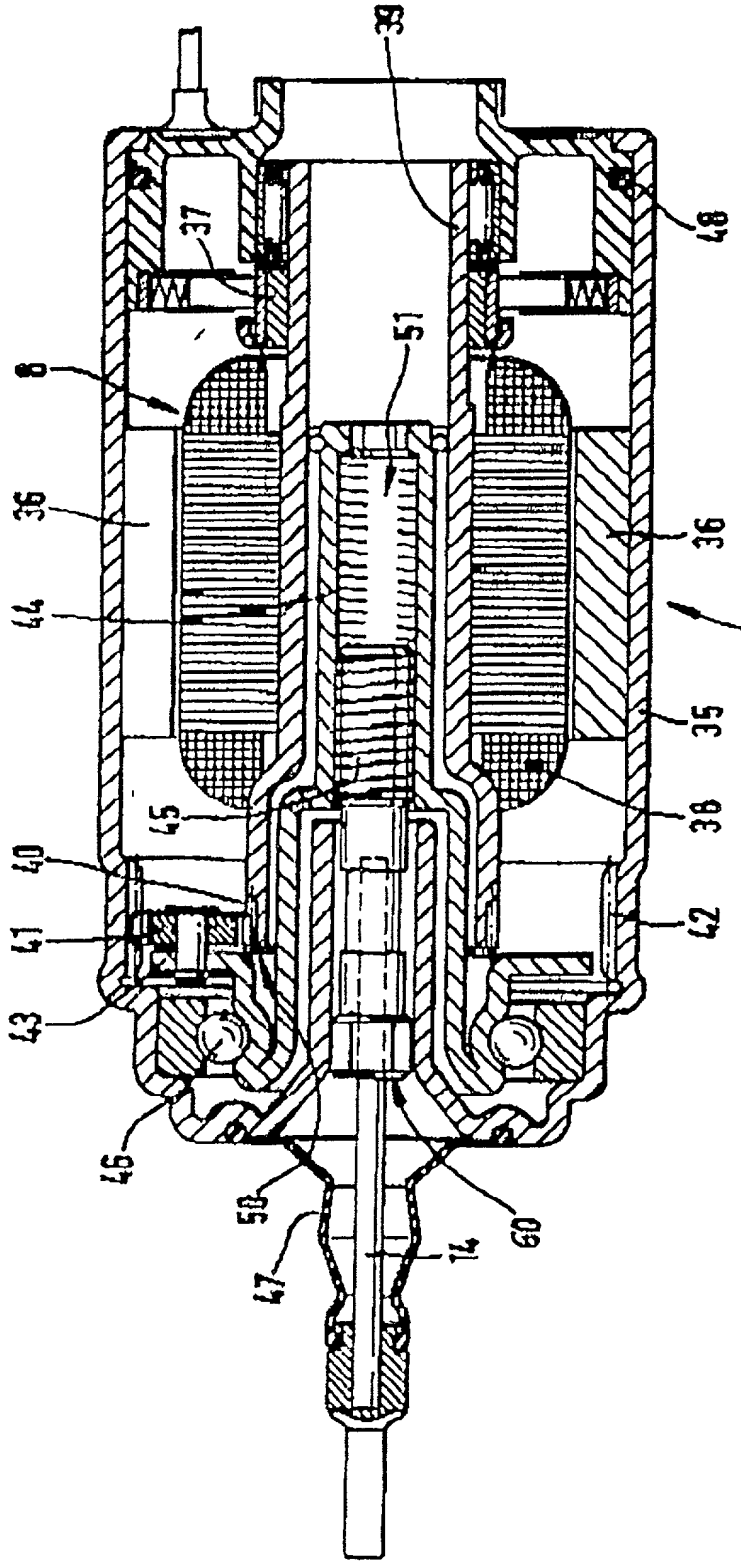


Fig. 3

Approved for use through 9/30/98. OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

AP8985

Declaration and Power of Attorney for Patent Application
Erklärung für Patentanmeldungen mit Vollmacht

German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

daß mein Wohnsitz, meine Postanschrift und meine Staatsangehörigkeit den im nachstehenden nach meinem Namen aufgeführten Angaben entsprechen, daß ich nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent für die Erfindung mit folgendem Titel beantragt wird:

ELECTROMECHANICALLY ACTUATED PARKING BRAKE FOR MOTOR VEHICLES

deren Beschreibung hier beigefügt ist, es sei denn (in diesem Falle Zutreffendes bitte ankreuzen), diese Erfindung

☒ wurde angemeldet am 26 March 98
unter der US-Anmeldenummer oder unter der Internationalen Anmeldenummer im Rahmen des Vertrags über die Zusammenarbeit auf dem Gebiet des Patentwesens (PCT) PCT/EP98/01798.

Ich bestätige hiermit, daß ich den Inhalt der oben angegebenen Patentanmeldung, einschließlich der Ansprüche, die durch einen oben erwähnten Zusatzantrag und in einem "preliminary amendment" abgeändert wurden, durchgesehen und verstanden habe.

Ich erkenne meine Pflicht zur Offenbarung jeglicher Informationen an, die eventuell zur Prüfung der Patentfähigkeit in Einklang mit Titel 37, Code of Federal Regulations, § 1.56 von Belang sind.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

ELECTROMECHANICALLY ACTUATED PARKING BRAKE FOR MOTOR VEHICLES

the specification of which is attached hereto unless the following box is checked:

☒ was filed on 26 March 98
as United States Application Number or PCT International Application Number PCT/EP98/01798

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above and as amended in a preliminary amendment.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

German Language Declaration

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäß Title 35, US-Code, § 119 (a)-(d), bzw. § 365(b) aller unten aufgeführten Auslandsanmeldungen für Patente oder Erfinderurkunden, oder §365(a) aller PCT internationalen Anmeldungen, welche wenigstens ein Land ausser den Vereinigten Staaten von Amerika benennen, und habe nachstehend durch ankreuzen sämtliche Auslands- anmeldungen für Patente bzw. Erfinderurkunden oder PCT internationale Anmeldungen angegeben, deren Anmeldetag dem der Anmeldung, für welche Priorität beansprucht wird, vorangeht.

I hereby claim foreign priority under Title 35, United States Code, §119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Applications (Frühere ausländische Anmeldungen)			Priority Not Claimed Priorität nicht beansprucht
197 14 046.7	Germany	5 April 1997	☐
Number	Country	Day/Month/Year Filed	☐

Ich beanspruche hiermit Prioritätsvorteile unter Title 35, US-Code, § 119(e) aller US-Hilfsanmeldungen wie unten aufgezählt.

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s)listed below.

Application No., filed on Filing Date

Application No., filed on Filing Date

Ich beanspruche hiermit die mir unter Title 35, US-Code, § 120 zustehenden Vorteile aller unten aufgeführten US-Patentanmeldungen bzw. § 365(c) aller PCT internationalen Anmeldungen, welche die Vereinigten Staaten von Amerika benennen, und erkenne, insofern der Gegenstand eines jeden früheren Anspruchs dieser Patentanmeldung nicht in einer US-Patentanmeldung, bzw. PCT internationalen Anmeldung in in einer gemäß dem ersten Absatz von Title 35, US-Code, § 112 vorgeschriebenen Art und Weise offenbart wurde, meine Pflicht zur Offenbarung jeglicher Informationen an, die zur Prüfung der Patentfähigkeit in Einklang mit Title 37, Code of Federal Regulations, § 1.56 von Belang sind und die im Zeitraum zwischen dem Anmeldetag der früheren Patentanmeldung und dem nationalen oder im Rahmen des Vertrags über die Zusammenarbeit auf dem Gebiet des Patentwesen (PCT) gültigen internationalen Anmeldetags bekannt geworden sind.

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

Application No., filed on Filing Date

Status: patented/pending/abandoned

Application No., filed on Filing Date

Status: patented/pending/abandoned

Ich erkläre hiermit, daß alle in der vorliegenden Erklärung von mir gemachten Angaben nach bestem Wissen und Gewissen der Wahrheit entsprechen, und ferner daß ich diese eidesstattliche Erklärung in Kenntnis dessen ablege, daß wissentlich und vorsätzlich falsche Angaben oder dergleichen gemäß § 1001, Title 18 des US-Code strafbar sind und mit Geldstrafe und/oder Gefängnis bestraft werden können und daß derartige wissentlich und vorsätzlich falsche Angaben die Rechtswirksamkeit der vorliegenden Patentanmeldung oder eines aufgrund deren erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

German Language Declaration

VERTRETUNGSVOLLMACHT: Als benannter Erfinder beauftrage ich hiermit den (die) nachstehend aufgeführten Patentanwalt (Patentanwälte) und/oder Vertreter mit der Verfolgung der vorliegenden Patentanmeldung sowie mit der Abwicklung aller damit verbundenen Angelegenheiten vor dem US-Patent- und Markenamt:

(3)

Joseph V. Coppola ~~33,373~~
Kevin Rutherford 40,412
Michael B. Stewart 36,018

Korrespondenzadresse:
Joseph V. Coppola, Sr.
Rader, Fishman & Grauer PLLC
Suite 140
1533 N. Woodward Avenue
Bloomfield Hills MI 48304
Telefon: (248) 594-0650

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

Joseph V. Coppola 33,373
Kevin Rutherford 40,412
Michael B. Stewart 36,018

Correspondence Address:
Joseph V. Coppola, Sr.
Rader, Fishman & Grauer PLLC
~~Suite 140~~
1533 N. Woodward Avenue
Bloomfield Hills MI 48304
Phone No.: (248) 594-0650

1-00 Rolf WEILER Rolf Weiler 14/1.99 Signature Date Zum Kohlwaldfeld 20 D-65817 Eppstein DE Germany Citizen of Germany	2-00 Werner DENHARD Werner Denhard 20-1-99 Signature Date Dietrichsberg 7 D-63607 Wächtersbach DE Germany Citizen of Germany
3-00 Jürgen BALZ J. Balz 99-01-20 Signature Date Birkenstrasse 20 D-65510 Hünstetten-Oberlibbach DE Citizen of Germany	Full name of fourth joint inventor, if any Signature Date Street Address City State/Country Citizen of

☐ If box is checked, subsequent inventors are listed on a separate sheet